Remarks/Arguments

The amended specification contains no new material. **My signature on this letter is my declaration that no new material is included in the amended specification submitted herein.** I have responded to the examiners request to remove the informalities and rewritten my claims to conform to patent office requirements.

I have narrowed my claims to reflect what I believe represents an advance over the prior Patented state of the art. I claim a device to keep the heat transfer loop between solar collector and hot water tank, filled completely with an automotive type antifreeze/water mixture, where air is removed from the heat transfer fluid by the normal thermal expansion of the heat transfer fluid in the day and its subsequent vacuum caused by thermal contraction upon cool down at night. Excluding the non-condensable gases, such as air, is important, because air speeds up corrosion by causing the antifreeze water mixture to oxidize and form acids, which can corrode the containment metals, like copper and brass.

The radiator system claimed is capable of safely dissipating the heat collected by the solar collector to the outside air if fluid circulation stops, by allowing the fluid to boil under pressure in the solar collector, the steam then moves up due to its lower density to the pressurized radiator where it is condensed back into water giving up its heat to the surrounding air. The steam based heat pipe from the solar collector to the pressurized radiator depends on the buoyancy of steam in hot water to rapidly move the steam from the solar collector to the pressurized radiator. Non-condensable gases, such as nitrogen, from air whose oxygen has dissolved in the heat transfer fluid or air in the solar collector, effectively block the steam from moving rapidly from the solar collector to the pressurized heat exchanger, creating air pockets for the steam to move through. Since hot air and steam are close together in density, the buoyancy forces for steam in air are much less than steam in water and the steam slows way down. Thus the non-condensable gases render the steam heat pipe ineffective at cooling the solar collector. Hence non-condensable gas removal is important to the claimed advance.

I have also claimed a pressure activated damper system to dissipate solar collector heat if the fluid circulation stops. When boiling takes place in the solar collector the steam pressure activates a mechanism which opens air valves on the top and bottom of the solar collector allowing air to flow over the heat absorber and cool it sufficiently to stop the boiling. I believe the air exclusion system, pressurized liquid to air radiator and pressure activated dampers have not been anticipated nor claimed by the prior art.

I have cancelled claims 5 through 12, because they were variations of the fluid heat transfer loop that were anticipated by prior art. Claim 4 was previously cancelled for being anticipated by prior art in umbilical design.

The solar system in Claim 1:
The heat transfer between the solar collector and hot water tank loop uses a self-pressurizing (via fluid thermal expansion or water to steam phase change) water based antifreeze fluid at about 16 PSIG pressure, with a means to control the pressure at 16 PSIG, a means to catch the fluid overflow, and a means to return fluid without non-condensable air to the antifreeze fluid loop, keeping the antifreeze loop full of fluid, while excluding non-condensable air. The heat transfer loop pressure is managed by a pressure relief valve; the fluid recovery from the overflow reservoir below water line is managed by a vacuum relief valve. Upon system cool down, steam condensing and thermal contraction of the heat transfer fluid cause a vacuum in the fluid loop. Liquid only is drawn back into the fluid loop via the vacuum relief valve, since the fluid loop is now below atmospheric pressure. Non-condensable gases in the fluid loop are swept by normal fluid flow to the highest point in the system, which is just below the pressure cap. Every time the system heats up thermal expansion of the heat transfer fluid compresses these non-condensable gases and forces them out of the overflow. These expelled gasses bubble up through the fluid in the overflow reservoir. Every time the system cools down, only liquid is returned to the system. This heat up and cool down cycle, happens on every sunny day and sometimes more than once if clouds come over.

In Embree (US 4269167) the system is pressurized with air to four psi, with water as the heat transfer fluid and several cubic feet of air, so the air can displace the fluid in the solar collector so the fluid can drain back out of the collector and piping. In Embree, fluid flow stoppage will allow air into the collector, as the fluid drains out of the collector. Embree does not have a provision to prevent the solar collector from overheating if fluid flow stops. The collector metal temperatures can reach in excess of 500 ° Fahrenheit, without the water present. In addition the air pressurized in the system will dissolve in the water and accelerate system piping corrosion. Incomplete drain down of the system can cause pipes to burst from freezing. Embree does not anticipate a system full of water based automotive type antifreeze fluid, without air, which keeps the solar collector from overheating when the pump is shut off.

Scharfman (US 4043317) does disclose an over-temperature protection system using dampers to cool the solar collector if circulation stops. He does anticipate dampers, but not claim their activation by system pressure, which is the basis for my Claim 3. Scharfman claims thermostats and bimetallic means to sense collector temperature and open his damper. He does not claim the use of pressure, because his solar collector is self contained and could be used with any suitable heat transfer loop, pressurized or un-pressurized. Hence he did not anticipate the use of pressure activated dampers.

Sigworth, Jr. (US 4413615) recites a solar system that uses a heat transfer oil between the solar collector and storage tank. His oil does not boil or freeze between -40 ° and 500 °

Fahrenheit. The oil has a low vapor pressure, so he does not need a pressurized system. He uses thermal buoyancy forces to move the fluid. He uses an expansion tank and simple backflow check valve. If his valve sticks closed and fluid circulation stops, the oil can reach 500 ° Fahrenheit and break down in the collector. He has no phase change from water to steam to help protect his system from over-temperature. Oil does not undergo the phase change I recite, water to steam, to limit the collector temperature, and generate the pressure needed to operate pressurized radiator heat pipe or the pressurized dampers to keep the collector cool. He does not anticipate a water based antifreeze fluid as I claim.

Zinn (US 4413615) recites the umbilical that I had claimed as claim 4. I have canceled this claim, since it is already patented.

I believe that the improvements I claim are not anticipated by the patents cited above when taken together. None of them contemplate a water to steam phase change at 16 psi pressure and 265 ° Fahrenheit, which gives rise to two improvements. The steam formed in the solar collector can be condensed in the pressurized radiator dissipating the heat. This steam heat pipe effect is not available to any of the referenced patents cited above. Embree never generates steam, Sigworth uses oil and Scharfman does not claim a heat transfer fluid. Goto uses the heat pipe, but at one atmosphere and allows non-condensable air into the system, which will dramatically reduce the heat pipe effect. The steam pressure can also be used to actuate dampers which allow air to cool the collector. Scharfman has the dampers, but no steam to operate them. The patents cited above, do not have a means of allowing the liquid and the steam to escape forming a space with only condensable gas (steam) and no non-condensable gas, air, through a pressure relief valve with overflow/recovery reservoir and only liquid to be returned to the system via a vacuum relief valve to keep the system full of fluid and exclude air.

The improvements derived from the pressurization and air elimination are significant and not obvious. Air elimination prevents normal water based automotive type antifreeze oxidation by air to form acids. Lower acid formation reduces corrosion, which increases the system life. Increasing and controlling pressure keeps hot, dry pockets of air from forming in the collector where the fluid has boiled out. Antifreeze temperatures over 300° Fahrenheit can occur and will oxidize the antifreeze rapidly causing it to turn dark and become strongly acidic and corrosive, dramatically decreasing system life. I believe that the combined benefits of air elimination and pressurization together are not obvious to those skilled in the art.

The Boiling Activated Pressurized Radiator Heat dissipation system Claim 2:

The solar collector will begin boiling at 265° Fahrenheit if the fluid circulation stops, since the pressure relief valve is set at 16 PSIG. The steam from the solar collector

makes its way toward the pressure relief valve through a liquid/steam separator. Before the steam gets to the pressure relief valve, it encounters the pressurized liquid to air radiator, where it condenses from steam back into liquid. Most of the steam never gets to the pressure relief valve, where it could exit the pressurized fluid loop and be injected into the bottom of the overflow recovery reservoir, where it would be condensed into liquid by the liquid in the reservoir. Any steam left in the solar collector when the sun goes down will condense causing a vacuum in the solar collector fluid loop. This causes the vacuum relief valve to open letting fluid from the bottom of the overflow reservoir reenter the closed fluid loop. Air over the fluid in the reservoir can not enter the closed fluid loop, since the entrance is always below water level.

Prior art Goto et al (JP 59-93149 A) recites that the solar collector with water based antifreeze fluid which will boiling at 220° Fahrenheit. Goto's system is open to the atmosphere via vent tube (8). His system does not have pressurization, and is open to the atmosphere, so air will be allowed into the system enhancing corrosion of the fluid containment metals. Goto does not recite a pressure relief valve, vacuum relief valve or overflow reservoir, to keep the system full of fluid. The Goto system looks very similar, but his radiator is un-pressurized so a 50/50 water/antifreeze mixture would boil at 220° Fahrenheit, much lower than the 265 ° Fahrenheit I claim using 16 PSIG pressure. Goto et al does not recite a method to keep air out of his system. This air dramatically reduces the heat transferred from the solar collector to the liquid-to-air-radiator, since the non-condensable gas, air, can get into the solar collector and form pockets of air which will slow the movement of the steam. This slowing occurs, because the density of hot air and hot steam are similar reducing the steam buoyancy and speed, compared to hot steam in hot water, where the steam and water densities are quite different.

The improvements derived from the pressurization and air elimination are significant and not obvious. Air elimination prevents normal water based automotive type antifreeze oxidation by air to form acids. Lower acid formation reduces corrosion, and increases the system life. Increasing and controlling pressure keeps hot, dry pockets of non-condensable air from forming in the collector where the fluid has boiled out. Antifreeze temperatures over 300° Fahrenheit can occur and will oxidize the antifreeze rapidly causing it to turn dark and become strongly acidic and corrosive, dramatically decreasing system life. I believe that the combined benefits of air elimination and pressurization together are not obvious to those skilled in the art.

The pressure activated solar collector over-temperature protection Claim 3:

The solar collector damper activation unit uses the pressure generated by the solar collector boiling at about 265° Fahrenheit to open airflow dampers on solar collector. This system uses the steam pressure to operate a piston to open the dampers on the solar collector. When the collector cools, the steam generation stops and the dampers close.

Scharfman (US 4043317) does disclose an over-temperature protection system using dampers to cool the solar collector if circulation stops. Scharfman uses temperature activation devices, expanding wax, bimetals, electronic temperature sensors controlling actuators; however he does not claim system pressure as an actuating mechanism. Scharfman has the dampers, but no steam to operate them. Scharfman claims the collector as a free standing part of any heat transfer system, both pressurized as well as un-pressurized. Hence, he only claims means that do no depend on system pressure. I specifically claim pressure activation for a filled closed loop antifreeze system.

Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

Respectfully Submitted,

Barry L. Butler PhD

Dr. Barry L. Butler
Tel: 858-259-8864

Sept 30, 2005

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to:

Assistant Commissioner for Patents
~~Washington, D.C. 20231~~ P.O. Box 1450
Alexandria, VA 22313-1450

on 10/01/2005 (date).

Barry L. Butler
(Typed or printed name of person signing this certificate)

Signature Barry L Butler - Barry L Butler

Date 10/01/2005